

PLATING RECTIFIER

Plating is all about a process through which a conductive surface is coated with a metal. The reasons for electroplating metals is to make them more attractive looking, to inhibit corrosion, to reduce friction, to harden the metals, enhance their paint adhesion, improve their capacity for solder and many other reasons.

The direct current DC which is essential for a successful plating process can come from a low-voltage generator or a rectifier. Initially, the generator was the main source of direct plating current, but because these generators were very costly to acquire and maintain, rectifiers became the cheaper alternative.



Rectifiers are so versatile that many devices make use of them. Some of the devices that work with rectifiers are:

1. Radio detectors or signals
2. DC power supplies
3. High-voltage DC power transmission systems
4. Household appliances like laptops, video games. Notebooks and televisions
5. Electroplating units.

Plating rectifier is an important part of the electroplating process. Some plating forms require the use of electrical current for depositing the coating material onto the metal part. These conductive parts are dipped into the plating tank or bath, and then, direct current DC will be applied by the rectifier that is between the electrode and the parts. The application of the direct current DC causes an attraction between the electric-field-driven coating and the conductive part of the metal. This attraction results in the coatings depositing on the parts. The coating requirements necessitate the controlling and filtering of both ripple voltage and DC voltage to achieve a high-quality finish.

A rectifier is responsible for converting alternating current (AC) to direct current (DC). This electrical device is made up of one or multiple diodes that are responsible for the conversion from AC to DC. This part of the rectifier called a diode is a one-way valve that enables current to flow in just one direction. When current begins to flow in that one direction, the process is called rectification. There are few important parts of the rectifier which you have to know:

Transformer; a rectifier transformer is responsible for reducing the voltage. It has both primary and also secondary magnetic cores which are wound with the conductive wires. To know the rate at which the transformer steps down the voltage that passes through it, it will be, the number of wire turns on the primary magnetic cores to the total wire turns around the rectifier's secondary magnetic cores. You can depict this mathematically as Primary=400 turns, Secondary is 10 turns, therefore, the ration becomes, 40:1. This means that if the input to primary is 480v, the secondary output will be 12v (480/40) However, most electroplating process makes use of 6-18v, and you can easily get a rectifier that will produce direct current at 50-10,000 amperage or more.

Rectification and the control system

When the alternating current produces a wave on an oscilloscope which oscillates both below and above the horizontal, the rectifier will filter out the lower part of the wave. When this filtration occurs, half-way rectification occurs.

Modern conductors make use of a semiconductor to carry out the filtration process, and when AC is removed, direct current will now flow through. The diode is one of the devices used by a rectifier to carry out the conversion.

Silicon also works as a controller for plating rectifier. These devices are called thyristors or SCR "silicon-controlled rectifiers." Although they are diodes, they require a control signal at a "gate" or terminal. The SCR works as a regulator and a rectifier depending on if it is used on either the primary or secondary side of the rectifier transformer.

The designing of the SCR on any of these two sides will depend on what you are using the rectifier for, i.e., the application, the efficiency of your unit, the cost implication and the reliability. Before offering any rectifier, it will be good for the supplier to consider what you need and give you a detailed explanation of which one will suit the needs.

Ripple

SCR might be effective, but they have one problem which is producing a direct current that is contorted by "Ripple." Some of the larger plating rectifiers produce ripple that is five percent or below at their rated capacity. If this is the case with your rectifier, it is never a good idea to operate it because, as you power the unit down, ripple increases.

If you want to electroplate precious metals, chromium, alloys, etc. your process requires a lower ripple rate. However, if the ripple is higher than necessary, you can add a filter, and it will smoothen the rectifier wave. Although when it comes to electroplating, the ripple is not that important. Therefore, if you want to specify a plating rectifier, tell the suppliers that it must come with a five percent ripple or lower than five percent to ensure that the plating processes will run smoothly.

Waveform

There are also some waveforms which a rectifier has:

1. Full Wave; this wave reverses the AC wave negative part and joins it with positive
2. Half Wave; it allows either the negative or the positive to flow through while blocking the other one.
3. Single-Phase AC; a center-tap transformer leads to the formation of a full-wave rectifier by two diodes.
4. Three-Phase AC; makes use of three pairs of diodes.

Another important factor you must chip into the supplier is the current waveform of the plating rectifier. Although a rectifier can come in any of the above waveforms, the appropriate waveform for many of the plating processes is a full-wave rectifier. This factor is critical because if you are handling a chromium electroplating process, it will not work with a half-wave rectifier.

There are other parts of a plating rectifier like a voltage and current control, overload protection and also a cooling device. The commonly used material in a rectifier diode is Silicon. To handle the load, several of these diodes are used. When the rectifier is in full operation, it generates a lot of heat and to remove this heat; there is always a water cooling system or a fan. All electroplating rectifiers make use of variable output control. If you have either an infinitely variable control or tap switches, you can use it. There are fixed output rectifiers available, and they are more affordable but not suitable because they may break down as a result of load factors if the plating shop is always busy. There are other controls as well as current density control, automatic voltage and current which make the work of the plater very easy by providing a consistent output. A rectifier can come in different shapes of many physical forms like it can be a solid-state diode, mercury physical forms, vacuum tubes diodes, silicon-controlled rectifiers and many semiconductor switches that are silicon-based.

Characteristics of a Rectifier

There are many important characteristics of a rectifier which makes them more suitable than a low-voltage generator for electroplating processes:

Rectifier saves energy; it adopts a high-frequency switching power supply transformer and as a result, the efficiency at which it converts current improves.

It is lightweight and also very small; if you have a thyristor rectifier, the size and weight will be 1/5-1/10. This weight and size make it very easy for you to expand, plan, install, maintain and move as the case may be.

Easy modulation; Rectifier output waveform can be modulated. Due to high frequency, the cost of output waveform adjusting processing is low and can be easily changed depending on what the users require. As a result, there will be room to improve the efficiency on site and also improve the quality of processing product.

Stability of output; the system has a high response speed, and as a result, the rectifier can adapt strongly to load changes and electricity network. This characteristic will ensure the accuracy of more than 1%. Also, the switching power supply works very efficiently to enable high precision control which will, in turn, improve the products quality.

Application features of a rectifier

There are many rectifier application features like

1. Reduction of porosity; as the rate at which nuclei forms is greater than the rate of growth, it leads to nuclei refinement.
2. Improve the binding force; rectifier enable the film to break down, and as a result, there will be a strong bond between the coating film and substrate.
3. It enhances the capacity for coverage and dispersion
4. It helps to reduce the stress on the coating; a rectifier help to reduce internal coating stress and as a result, there will be a reduction of additive and an achievement of a crack-free coating film.
5. Rectifier helps a lot if you want to achieve an alloy coating composition that is stable.
6. With a rectifier, there will not be a need for anode activator since it improves the dissolution of an anode.

Rectifier improves coating mechanical properties like increasing density, reducing volume and surface resistivity, improve wear resistance, toughness, corrosion resistance and also enable the controlling of the electroplating coating hardness.

Rectifier Placement

The right place to keep the rectifier is as close to the electroplating tank as possible. If you place the rectifier too far from the plating tank, it will make the bus run longer resulting in loss of current and maintenance. The main reason for keeping the rectifier close to the tank is because the components of the rectifier need cooling and if you allow them to cool under the air, it will draw corrosives faster and also shorten the life of the rectifier.

The best and easiest way to solve the rectifier placement problem is to keep it over a wall that is near so that it will be closer to the plating tank. You can still keep the rectifier controls next to your electroplating station. However, if you cannot keep it on the other side, you can use air-tight or water-cooled units directly or through heat exchange. Also, you may need to use water to cool your rectifier if the ambient air is above the required temperature.

Maintaining and repairing a rectifier

A rectifier has only pumps or fans as moving parts which are used to cool it. If you install and operate your rectifier at the specified temperature levels, it will last for a very long time. As for maintenance, you can do it regularly like other equipment. Just clean the air filters regularly or change them as the need arises. Make sure that you remove any object like boxes or other objects that may inhibit the flow of air. Always check the fan blades to make sure that they are secure. Run maintenance exercise on filters and pumps. Clean the heat sinks and the semiconductors clean to enhance cooling. Thoroughly check all the instrumentation for control like buttons, lights, etc. on a regular basis and change any of them whenever you discover malfunctioning.

A good brand of rectifier comes with an onboard diagnostics that indicate areas of trouble on the digital display. Voltmeters, Ammeters, and oscilloscopes help the unit to show the trouble area. There is no special skill or a degree in engineering needed before repairing a faulty rectifier. The only thing you should have is an understanding of electrical equipment and also knowledge about the dangers of high currents and high voltages.



The good news is that the people who supply rectifiers will always include a detailed manual and the list of parts so that you can easily repair the rectifier and reduce the number of downtimes you experience.

There are certain things you must consider before you buy any rectifier. There are some things you are noticing about your current rectifier which you may want to improve or maintain your next purchase. Also, your supplier may also make some reasonable suggestions on the features that will improve your work efficiency.

On a general note, you should check out the following before you buy a rectifier:

1. Ease of installation
2. Maintenance costs (preferably lower)
3. Repeatability
4. Reliability
5. Warranty
6. Conversion Efficiency.

Although there is no way of knowing how superior a rectifier is, you can ask others about their experience and also maintain a trust relationship with your supplier so that he will always tell you the truth.

There are different types of plating rectifiers which you must know.

100 A Plating Rectifier

Since electroplating follows an electrolytic process to ensure adequate coating, it is important to know that the power supply plays a very significant role in the whole process. You must understand and verify how the power supply performs, the type of power supply that you need and the characteristics since all of these factors play a significant role in the plating process.

In this era, the constant and increasing development of modern plating technology is causing the importance of plating rectifier to grow at an alarming rate day by day. Therefore, you must understand the impact which plating rectifier play in the electroplating process.

High frequency switching electroplating rectifier

This type of rectifier is also called HF switching power supply, and it is a new plating rectifier for electroplating machine. This rectifier comes with an easy to adjust voltage and waveform smoothness which is a combination of the advantages of silicon-controlled rectifiers and silicon rectifier. It also has a high current efficiency of about 90%, the smallest volume, making it a promising electroplating rectifier. As for the power problem, the manufacturers have taken care to resolve it by providing thousands of amperes power.

How it works

The conversion process makes the alternating current (AC) grid by EMI anti electroplating interference filter, direct rectification, filtering wave, the inverter convert the direct current DC into tens or even hundreds of KHz square wave frequency. Afterwards, using high-frequency transformer isolation, it reduces the voltage, and with a high-frequency, it filters out the DC voltage output.

After passing through sampling, comparison control and amplification, the circuit and power converter controls the cycle of IGBT and obtain a stable and consistent output current.

HF was switching electroplating rectifier control tube while the unit is working to ensure minimal loss of power consumption and that efficiency gets to 75-90%. The small size, lightweight, accuracy and the ripple factor of high-frequency switching rectifier are better than that of silicon rectifier. The whole output is accurate for what the platers require during production. Also, the plating rectifier can protect itself adequately. It can start or stop under loading. You can also connect it easily to your computer for automatic production, and this promotes convenience.

Plating High-frequency switching rectifier conversion structure has forward converter, full-bridge, half bridge, etc. It has PWM Pulse width modulation HF switching power supply, the frequency it maintains during operation is below 50 KHz with a current or voltage feedback control.

The plating rectifier changes the voltage pulse width so that it can adjust output current by interrupting the power flow and adjusting the method of the duty cycle. These processes make the rectifier to work in a solid switching state which will force conduction or force shutdown resulting to high pressure on the power transistor and large loss of current when the rectifier is switching on and off.

This high-pressure peak which arises as a result of transformer leakage and change in current rate causes damage to the power tube and produce electromagnetic radiation which in turn, reduces the power efficiency and reliability of the rectifier.

200 A Power Supply rectification technology

Power supply frequency is a DC equipment which changes alternating current AC into a different waveform, voltage, and frequency. The power supply has the following features:

1. Changes current to different voltage, waveform, and frequency
2. The components are main circuit and control circuit

3. The power frequency is 50Hz/60Hz
4. Application: anodizing, chrome plating, zinc plating, copper plating and another metal plating
5. It is a better alternative to an oil dip power supply and silicon-controlled rectifier.

The main circuit of the Power supply is made up of a transformer, testing devices, power rectifier components and protection devices. The main transformer works to reduce the alternating current to the required voltage value of the plating process. If it is a Thyristor rectifier, it uses a frequency of 50/60Hz, but if it is a high-frequency switching power supply, it uses 10-50 KHz transformer.

There are also some detection devices like voltage meter and current transformers. The protection device on power supply rectifier is for protecting power rectification components against over-current. The control circuit is made up of IGBT or thyristor, power soft-start circuit, over-current, trigger control circuit, power phase protection circuit and over-voltage protection circuit.

300 A DC power supply

Before choosing a dc power supply, you must ensure that it meets the following requirements:

1. It should meet the plating process requirement which includes dc power supply power, adjustable range of current and voltage, etc.
2. You must also check the reliability of power supply from the DC power supply which entails, structure reasonability, cooling methods, line features, and security.

Cost performance of the DC power supply

After checking these three requirements, then you have to determine the kind of DC power supply that will suit your requirements. The first thing you have to do is to determine the type of plating you want to do and the kind of DC power supply which your electroplating tank needs.

To determine the above, you can use these two methods:

1. Determine the DC power supply by using the plating solution to know the volume current density
2. Calculate your DC power supply needs by the plating area so that you can get the plating current density per unit.

There are some examples you can follow to choose the appropriate DC power supply:

1. Nickel plating is 0.1 -2.5 A/L
2. Bright nickel electroplating is 0.3-0.35 A/L
3. Copper plating is 0.2-0.3 A/L
4. Acid zinc plating is A/L
5. Chrome plating is A/L
6. Alkaline zinc plating is 1.2 A/L

If you want to do Bright nickel plating with 600L plating bath maximum process current is $0.3 \text{ A/L} \times 600\text{L} = 180\text{A}$. Therefore, you can choose 200 A DC power supply.

You can also calculate the maximum current according to the plating area volume.

Let's say you want to do chrome plating if you are going to use

1. Plating bath of 600 L
2. Temperature at a 60 degrees Centigrade
3. Maximum current density of 100 A/dm²,
4. The tank at 10dm² which is a full load setting

Therefore, your power requirement will be at maximum output current is $100\text{A/dm}^2 \times 10\text{dm}^2 = 1000\text{A}$. This means that you need 1000 A DC power supply, 18 volts rectifier power supply.

When you are through with determining the DC power supply power, consider the requirements of the plating special treatment process and the condition of the plating site. The information will help you to select the cooling method, waveform, corrosion resistance, volume size as well as cost factors, etc.

500 A plating power supply

The plating power supply converts line frequency alternating current at various frequency, voltage and waveform DC equipment. If it is a thyristor, plating power supply and its primary application is the rectification technology but in a high-frequency rectifier, switching power supply using both inverter technology and rectification technology. The plating power supply is formed by a circuit and a control circuit.

Plating power supply is responsible for providing power to the different plating bath. There are different types of methods used for plating namely direct current plating, pulse electroplating, cycle pole reverse plating, etc. In the early days, the plating power supply which AC motors and DC generators units have been replaced by power electronic devices which are made up of plating power supply.

Voltage and Ampere

DC plating power supply has both low voltage and high-current DC power supply which is never above 48V. This requires that there will be a continuous adjustment since the output current can go as high as thousands of ampere. Plating power supply is often powered directly using the city power. Also, to improve the machine's power factor, direct current plating power supply can adopt a non-controlled rectifier circuit. However, the voltage regulator can be placed on the front side of the rectifier main transformer's AC, voltage regulator.

Often, the low voltage and the high-current of plating power supply rectifier circuit is used with a dual star balancing reactor circuit. You can use a remote control for Voltage regulators auto-transformers or motors. However, the downside to this is the slow time at which the regulators respond and also the easy-to-wear brush. One disadvantage of using stable reactor is that it produces low power. Also, the thyristor three-phase AC voltage regulator has its disadvantages which includes low power, but the response speed and the control results are better than the others.

600 A rectifier

This rectifier is often called switching Rectifier SMR. It supplies power through IGBT or MOSFET in a high-frequency operation. This switching frequency is controlled at the range of 50 KHz-100 KHz, with a ripple factor of less or equals to 1% so that it can attain miniaturization and high frequency.

During the 1960s there was a large-scale usage of linear regulator DC power supply, but it had many disadvantages of which volume weight was a part of its downsides. As a result of this volume weight, it was challenging to achieve miniaturization, there were a large loss and low efficiency, and there was also a common end between the input and the output and this made it difficult for the unit to achieve the isolation needed for AC and DC. It was easy for the unit to lower voltage but it couldn't increase it. This defect is why all those applications that are higher than 5A are now replaced by DC SMPS power unit. In the year 1964, there were two articles which Japan NEO magazine published about: "high-frequency technology make AC variable DC power supply miniaturization" and "Pulse modulation for power supply miniaturization."

The articles showed the direction of SMPS power unit DC power supply miniaturization research. The second one was how to use the techniques for pulse width modulation.

The year 1973, an article from Motorola which they titled "trigger from 20kHz of revolution. This article began a development of high-frequency switching power supply and DC/DC converter which became popular as a switching regulator for switching power supply. The power density was increased from 1-4 W/in³ to 40-50W/in³. It also became the first Buck converter to be adopted.

In the middle of 1980s, Buck, Boost and also the Buck-Boost converter was applied to SMPS power unit. There was another converter called the CUK converter. This converter and Buck-Boost converter were more of a duo in the 1980s, but gradually, they were also applied to switching power supply.

During 1976, P.W Clarke developed a transformer known as "primary inductance converter" which was also joined others in switching power supply applications.

After P.W Clarke, Bell laboratories in 1977 developed on the PLC basis another transformer which is "single-ended primary inductance converter," and it came with the transformer, SEPIC circuit and it is called dualSEPIC or Zeta converter.

By 1989 people have started applying SEPIC and Zeta to SMPS power unit which increased the switching power supply for DC/DC converter to 6 types. Right now, there are up to 14 types of DC/DC converter working as a switching power supply. This converter can meet any performance requirement, you can also design it anywhere, it works well with many applications, and it performs very highly.

750A AC to DC rectifier

This rectifier has the following features:

It makes use of components from famous brands and internationally advanced inverter technology of precision machining to ensure a stable, reliable and high-quality performance of the rectifier.

The rectifier is popular for over current, over voltage short circuit, over temperature, equal an automatic alarm, and soft-start function. This AC to DC rectifier can also be equipped with a control interface and a computer interface.

For the DC output, the waveform is high frequency while the ripple factor is less than 1%. There is a possibility of increasing plating, refusing passivation, enhancing the gloss of the coating surface and the main core or the dark corner of the coating. It can also reduce the unnecessary material loss and also meet the different requirements of the plating industry.

The cooling method

This high-frequency switching power supply rectifier uses an air cooling or water cooling system. It is very easy to install and

operate using the remote control. You can switch it off as you load to avoid the difficult adjustment procedures.

Advantages of AC to DC rectifier

It is small and has a lightweight. The whole machine makes use of anti-corrosion technology which enhances the products corrosion resistance abilities and thereby making sure that the machine will last a very long time.

It saves energy, and it provides high-efficiency current, and the efficiency can be above 90%. The rectifier also reduces the costs of plating, especially in the surface-treatment plating machine industry.

1000A Rectifier

This rectifier is used for the control functions required for the electroplating process:

1. Constant voltage automatic control
2. Constant current automatic control
3. Automatic constant current-constant voltage control
4. Ampere-hour control
5. Constant current density control.

To improve the power of the rectifier machine, it adopts a non-control rectification. Depending on the current and voltage requirements of the electroplating machine, you can change the angle of the thyristor voltage regulator phase shift control. The electric power supply is quite different from that of steel plating machine. So if you are running the electroplating process, you can adjust the single-phase alternating current, if there is constant electric power and through the exchange the electric current it can convert to DC.

If you are using the DC plating machine, the metal ions present in the electrolyte comes from the cathode plated on the same to reduce the concentration of the ions in the electrolyte that is near the cathode. This slows the deposition rate. As a result of this, you need to use a larger current density rectifier so that you can raise the plating speed. However, there are other disadvantages to it because it will increase the hydrogen, reduce the efficiency of the current resulting in deterioration of plating coating.

1500A plating Rectifier

To install this rectifier, you must ensure that you must keep it stable, make sure that there is adequate ventilation for it, also, from the rectifier to at least 0.5 meters around it shouldn't have any other machine. This space will improve the rectifier useful life. Also, avoid exposing the rectifier to things like dust, corrosive gases, heat and wetness. Let there be an ambient temperature of 25 degrees to 40 degrees centigrade with a humidity of 5-70%.

There is some important check you also need to run about the out cover of the rectifier:

1. Check to see if the cover is loosening
2. Examine the power end to see if there damages while in transit.
3. Make sure that the air switch is off and if there is any damage, avoid turning it on. Contact the supplier immediately.
4. If there is any loosening on the cover, check the input line to make sure that it didn't damage during transportation.
5. Connect the shell following the ground connection mark to avoid static electricity.

6. Turn the power knob to the counter-clockwise direction till the end.
7. Afterwards, run the following check tests on the rectifier
8. Turn on the air switch to make the fan rotate and the power indicator light to show
9. Use the adjustment button to rotate it to clockwise position to increase the voltmeter and show the working light.
10. Adjust the knob to the maximum position, this will show the rated voltage on the voltmeter, and the current meter will indicate the load volume.
11. Then disconnect the air switch and turn it off.

2000A plating power supply

There are some impressive characteristics of this rectifier which are as follows:

1. It is small and lightweight with about 1/5- 1/10 in size and weight for ease of planning, installation, maintenance, expansion, and moving.
2. It has an energy saving effect more than the silicon control rectifier.

This power supply rectifier produces a stable output. It is a system that has a response speed (microsecond), and as such, it can adapt to load changes and electricity network. It also has an accuracy that is higher than 1% and this help to improve the plating products.

Also, you can adjust the waveform of this rectifier without spending hugely.

3000A 12 volt DC power supply

This type of rectifier is more suitable for plating machine area, and you need basic knowledge about it. While using the 12 volt DC power supply, you can adjust it to your requirement. Also, it will be beneficial to carry out some inspection and maintenance exercises depending on where you are keeping it.

To use this rectifier properly, follow the following instructions:

1. Disconnect the external power supply 30minutes before you open the electricity power box
2. When you open the power box, clean the dust on each of the parts with a brush, dry cloth or using air
3. Ensure that the power supply is play
4. Make sure the air switch is intact
5. Check if there is noise from the fan
6. Ensure that there is no oxidation of the copper cable or bar.

Also, there are other important sealing conditions you must check like loose screws and nuts. Adequate water if it a water-cooling plating rectifier. If there are leaks, tighten the retainer immediately.

4000A Rectifier Supplier

This rectifier has unique features that aid performance. The machine has a sealed and closed water cooling structure. It is highly resistant to rust, corrosion, moisture effect and this feature ensures long-life service. The temperature is air-cooled, and anti-corrosion structure is promoting easy installation and maintenance. It saves power and has an efficiency of 85% and above.

There are many advantages to using 4000A rectifier:

1. Its small in size and light in weight ensuring ease of installation, operation, and maintenance.
2. It has protection functions against over-current, over-heat, over-voltage
3. It has time control, automatic shutdown and fast protection
4. There is a digital time current and voltage display
5. It gives constant voltage, options for constant current control, power factor, etc.
6. It is resistant to corrosion and acid.